GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

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Date: May 9, 1979

Project Title: A Study to Determine Labor Input Factors for Pricing Roof Trusses

Project No: A-2367

Project Director: R. B. Junk

Sponsor: Hoover-Universal, Inc.

Agreement Period: From 4/23/79 Until 5/31/79

Type Agreement: Standard Industrial

Amount: $900

Reports Required: Final Report

Sponsor Contact Person (s):

Technical Matters

Contractual Matters
(thru OCA)

Jack Smith
General Manager
Hoover-Universal, Inc.
P. O. Box 746
Madison, Georgia 30824

Defense Priority Rating:

Assigned to: Technology & Development (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director—EES
Accounting Office
Procurement Office
Security Coordinator (OCA) ✓
Reports Coordinator (OCA)

Library, Technical Reports Section
EES Information Office
EES Reports & Procedures
Project File (OCA)
Project Code (GTRI)
Other

CA—3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: August 13, 1979

Project Title: A Study to Determine Labor Input Factors for Pricing Roof Trusses

Project No: A-2367

Project Director: R. B. Junk

Sponsor: Hoover-Universal, Inc.

TERMINATED

Effective Termination Date: 5/31/79*

Clearance of Accounting Charges: 5/31/79

Grant/Contract Closeout Actions Remaining:

- X Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other _____

*Per R. B. Junk, we can bill for charges incurred in June up to the maximum amount of $900.

Assigned to: Engineering Ext. Div./IED (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director–EES
Accounting Office
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Library, Technical Reports Section
EES Information Office
Project File (OCA)
Project Code (GTRI)
Other _____

CA–4 (1/79)

Alice- i kept a cy. of this ltr. No need to send me one. Thx. MAS

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY

Y AND DEVELOPMENT LABORATORY
Augusta Area Office
500 Building, Suite 217
Augusta, Georgia 30902
Area Code 404/828-3901

June 21, 1979

A 2367
Final Rpt.

Mr. Jack Smith, General Manager
Hoover Universal-Building Products Division
P. O. Box 746
Thomson, Georgia 30824

Dear Jack:

The results of my study to assist Hoover management in establishing appropriate labor input factors for pricing roof trusses produced at the Madison, Georgia plant are presented in the 8 attachments to this letter.

A primary objective of this study was to develop the proper labor performance factors for use with Alpine Engineering's truss pricing program. The Alpine PRICE FILE form specified the production operations for which inputs are required (see Attachment 1), and this form was used as my main guide in the study.

A Master Summary of the time studies made at the Madison plant, categorized in accordance with the operation elements on Alpine's PRICE FILE form, is presented as Attachment 2. The timestudies listed in the Master Summary are assigned code numbers (the circled numerals in the extreme left column) which are used to refer to individual studies in other sections of this report.

Attachments 3 through 5 are more detailed breakdowns of several studies involving the component saw and the radial arm saw. The studies they relate to are indicated by the code numbers that appear in the upper right corner of each sheet. These breakdowns are included to demonstrate how certain work elements observed were combined to arrive at the operation times shown on the Master Summary. Attachment 3 also demonstrates that times during which the operator was delayed and/or interrupted were disallowed in the development of the basic operation times that appear in the Master Summary. Thus, for example, the time for the operation "Cut 1-pc. on Component Saw" (Study code (17)) includes the internal work elements necessary to the sawing operation (such as cutting and checking samples, removing cut pieces, etc.) but excludes all extraneous times such as delays to and interruptions of the sawyer.

Thus, although operation times that appear in the Master Summary are not to be construed as "standard times" per se, they can be taken to represent the time required for a given operation at "near - 100%" efficiency. That is, they indicate the time required for each operation at the observed operator pace when all extraneous times such as delays and interruptions are eliminated.

Attachment 6 presents the set of labor input figures recommended for Trial 1 with the Alpine truss pricing program. These figures are based on the "bare bones" operation times contained in the Master Summary. Use of this set of figures represents no attempt to account for all elapsed time that normally occurs in this plant. Use of these labor input figures in Trial 1 with the Alpine program was intended to establish a "base line" for establishing appropriate labor input factors.

Attachment 7, pages 1 through 3, shows how the operation times from the individual timestudies in the Master Summary were used to develop the set of labor factors recommended for the first trial with the program (Attachment 6). Note that: (a) only common trusses were observed, so no labor factors were recommended for Specials or System 42 trusses on the first trial, and (b) the "ASSEMBLY TIME PER PC" factor was developed (by timestudy) only for lot sizes from 16 to 99 trusses. Factors for all other lot sizes on the form (1 to 3, 4 to 15, and over 99) and for jobs with above-normal weights were derived by factoring the assembly time for the jobs observed in accordance with the example given in the Alpine Engineering program instruction manual.

During the initial trial with the Alpine truss pricing program, using the set of labor input figures in Attachment 6, it became evident that the resulting labor costs were extremely low in comparison to historic labor cost figures compiled by Hoover. This discrepancy was undoubtedly due to the fact that the recommended labor input figures do not account for all the time spent by the plant labor force including delays, idle time and other extraneous elements. It was determined that multiplying the individual recommended labor input factors in Attachment 6 by a factor of 2.19 brought the resultant labor cost in line with Hoover's historic breakdown of labor versus material costs. Applying this multiplier factor (2.19) "across the board" to the individual Attachment 6 operation times results in the set of labor input figures presented in Attachment 8. It is recommended that these labor figures be used in the future with the Alpine pricing program.

No doubt, these new labor inputs in Attachment 8 will be further refined with more frequent future use of the pricing program. I am certain, for example, that the multiplier factor that should be applied to the "position jigging" operation will differ from that which should be applied to the "cut (1) pc. on component saw" operation in order to best reflect the "real world" situation. However, the set of labor figures in Attachment 8 should be an adequate reflection of the efficiency of the overall operation and should be useful for application to the pricing program until such time that further refinements to the individual operation times can be made.

Also, it should be noted that the operation times in the Master Summary are a good indication of what can be done in the Madison plant to improve the overall plant productivity. Plant supervision should consider these times as goals to work toward in each operation to ensure the improved profitability of the Madison plant.

If you have questions concerning any aspect of this study, please don't hesitate to call me.

Sincerely,

Raymond B. Junk, II
Director
Augusta Area Office

RBJ/jh

Attachments

ALPINE SUPERX
EXPANDED TRUSS PRICING & ANALYSIS SYSTEM

PRICE File Data for Alpine Truss Pricing Programs

LUMBER PRICES

Line No	2'	4'	6'	8'	10'	12'	14'	16'	18'	20'	Lumber Length
	2x4 Price/1000 Board Feet										
10											Lumber Grade #1
11											Lumber Grade #2
	2x6 Price/1000 Board Feet										
20											Lumber Grade #1
21											Lumber Grade #2
	2x8 Price/1000 Board Feet										
30											Lumber Grade #1
31											Lumber Grade #2

LABOR RATE & MARKUPS

	$ Labor Cost per Man-Hour	*% Overhead	*% Profit	% Sales Comm.	% Discount	% Discount	% Sales Tax	*% Code 0=% of Cost 1=% of Sales
40								

LABOR PERFORMANCE FACTORS - MAN MINUTES

	Fetch Lumber to Comp. Saw	Set Up Component Saw	Cut 1-Pc. on Comp. Saw	Position Jigging	Get Materials	Handling & Banding	
50							Common Trusses
51							Specials
52							System 42

	Fetch Lumber to R/A Saw	Set Up R/A Saw	Cut 1-pc. on R/A Saw	
55				Common Trusses
56				Specials
57				System 42

ASSEMBLY TIME PER PC. (MAN-MIN) | WEIGHT FACTORS

	For 1 to 3 Trusses	For 4 to 15 Trusses	For 16 to 99 Trusses	Over 99 Trusses	for 50% More Gross Wt.	for 20% More Wt. per Pc.	
60							Common Trusses
61							Specials
62							System 42

MISCELLANEOUS FACTORS

	% Extra Cutting Effort for 18' & 20' lumber	Plate Cost per 100 Sq. In.	Flat Truss Splices 1 = Off Panel 2 = Panel Pt.	Maximum Lumber Length
70				

Code	Date	No. Obs	Operation	Description	Elapsed Min.	Crew Size	Man-Min (mm)	No. Trusses	mm/Truss	No. Pcs.	mm/pc.
50-A FETCH LUMBER TO COMPONENT SAW											
(8)	5/24/79	1	Fetch lumber to component saw	16' lumber	4.3	2	8.4				
(14)	4/25/79	-	Fetch lumber to component saw		5.4	2	10.8				
(20)	4/26/79	2	Fetch lumber to component saw	Standard lumber	1.6 (avg)	2	3.2				
50-B SET UP COMPONENT SAW											
(15)	4/25/79	4	Component saw	Set up (avg, for (1)	2.7	2	5.4				
(22)	4/26/79	1	Component saw	Set up	1.5	2	3.0				
50-C CUT (1) PIECE ON COMPONENT SAW											
(16)	4/25/79	-	Component saw	Saw time only	46.9	2	93.8			630	0.1
(17)	4/25/79	-	Component saw	Saw time & Auxiliary elements	83.3	2	166.6			630	0.3
(21)	4/26/79	-	Component saw	Saw time only	23.3	2	46.6			236	0.2
50-D POSITION JIGGING											
(4)	5/24/79	1	Position jigging	8 pcs-Double pitch	32.0	1	32.0				
(13)	4/25/79	1	Position jigging	T-1 Monoscissor 72 Trusses/0 Gables Left end of gantry	125.1	1	125.1				
(19)	4/26/79	1	Position jigging	25' Mono 3/12 pitch LE of gantry	85.0	1	85.0				
50-E GET MATERIALS											
(5)	5/24/79	1	Get materials	8 pcs-Double pitch	19.9	1	19.9				
(6)	5/24/79	1	Position plates	8 pcs-Double pitch	49.4	1	49.4				

ATTACHMENT 2

Code	Date	No. Obs	Operation	Description	Elapsed Min.	Crew Size	Man-Min (mm)	Trusses	mm/Truss	No. Pcs.	mm/pc.
50-F HANDLING AND BANDING											
(3)	5/24/79	4	Handling (Racking)	31'0" Howe-double cantilevered legs	3.3	1	3.3	4	0.8		
(7)	5/24/79	1	Banding (only)	31'0" Howe-double cantilevered ligs	6.1	1	6.1				
(25)	4/26/79	15	Handling (Racking)	Small double-pitch	8.6	1	8.6	15	0.6		
(26)	4/26/79	1	Banding (only) 14 trusses, 2 gables (5) bands	Small double-pitch	7.2	1	7.2				
(27)	4/26/79	1	Move banded trusses to yard storage	Small double-pitch	2.5	1	2.5				
55-A FETCH LUMBER TO R/A SAW											
(28)			Radial arm saw	Fetch lumber to R/A saw from yard		1	3.7	Same as avg. for Fetch to component saw (see Codes (8), (14), (20) except Crew = 1.			
55-B SET UP R/A SAW											
(9)	5/24/79	1	Radial arm saw	Set up	3.1	1	3.1				
55-C CUT 1 PIECE ON R/A SAW											
(10)	5/24/79	-	Radial arm saw	Cut time (Incl. interim setups and handling).	18.1	1	18.1	(See separate sheet)		15	1.2
(11)	5/24/79	-	Radial arm saw	Cut time (Incl. interim handling)	10.5	1	10.5	(See separate sheet)		30	0.4
60-C ASSEMBLY TIME PER PIECE (MAN-MIN) - FOR 16 to 99 TRUSSES											
(1)	5/24/79	10	Assembly	13'0" Howe-double cantilevered legs	15.8	5	79.0	10	7.9	11	0.7

ATTACHMENT 2

HOOVER UNIVERSAL-BUILDING PRODUCTS DIVISION
MADISON, GEORGIA PLANT

Code	Date	No. Obs	Operation	Description	Elapsed Min.	Crew Size	Man-Min (mm)	Trusses	mm/Truss	No. Pcs.	mm/pc.
(3)	5/24/79	10	Handling (Racking)	31'0" Howe-double cantilevered legs	3.3	1	3.3	4	0.8		
(12)	4/25/79	9	Assembly	Gable-monopitch	24.2	5	121.0	9	13.4	14	1.0
(18)	4/25/79	4	Assembly	T-7 Monoscissor 80 trusses/0 gables	7.7	5	38.5	4	9.6		
(23)	4/26/79	23	Assembly	34'0" 4/12 pitch Double pitch	44.4	5	222.0	23	9.7	12	0.8
(24)	4/26/79	13	Assembly	Small double-pitch	19.4	4	77.6	13	6.0	8	0.8

ATTACHMENT 2

(14) (15) (17)

ATTACHMENT 3

Component Saw
Study Date: 4/25/79
Crew: 2 (1 sawyer, 1 handler)
Cutting List: T-2 Mono truss
84 trusses/12 gables

	Elements	Elapsed Min	Crew	Man-min (mm)	Pcs Cut	mm/pc
	Fetch (F/L)	5.4	2	10.8	-	
	Saw set up	14.0	2	28.0	-	
	Set up (interim) adj.	* 3.1	2	* 6.2		
	Po. Bunk of Lumber	* 9.9	2	*19.8		
(16)	Saw	*46.9	2	*93.8	630	0.1
	Check cut sample	* 8.9	2	*17.8		
	Wait (delay)	5.5				
d	Interruption	3.2				
	Mark Lumber	* 2.4	2	* 4.8		
	Remove cut pcs	* 0.9	2	* 1.8		
	Ck/mark cut list	* 1.0	2	* 2.0		
	Pick up scrap	*10.2	2	*20.4		
17 (net)	Sum*	83.3	2	166.6	630	0.3

ATTACHMENT 4

Radial Arm Saw - Summary
Study Date: 5/24/79
Crew: 1
No. pcs cut: 15

Elements		mm	pcs	mm/pc	
		3.1 (initial)			
Set Up - Initial & Interim		1.2	15	0.1	(3.1 for initial setup)
Saw		11.8	15	0.8	
Material Handling		3.7	15	0.2	
Misc. (Allowable)		1.4	15	0.1	
10	*Totals	18.1	15	1.2	

Recommendation

Consider "Set Up" of Radial Arm Saw to be the initial setting of pitch and length. Then, the "cut one piece" includes: (a) actual saw time
(b) interim length changes
(c) interim handling at workplace
(d) allowable misc.

Also, "Fetch" includes only bringing a bunk of lumber to the R/A saw from component cutter, scrap pile, or yard.

*Does not include initial setup time of 3.1 mm.

Radial Arm Saw - Summary
Study Date: 5/24/79
Crew: 1
No. Pieces cut: 30

Elements	mm	pcs	mm/pc
Set up	--	--	---
Saw	5.4	30	0.2
Material Handling	3.5	30	0.1
Misc. (Allowable)	1.6	30	0.1
11	10.5	30	0.4

Recommendations/Comments

No interim set up adjustments required for the (30) pcs observed. Also, no initial setup (picked up with sawing operation in progress).

"Cut one piece" includes: (a) actual saw time
(b) interim material handling
(c) allowable misc.

and averaged 0.4 mm/pc.

"Fetch" includes only bringing a bunk of lumber to the machine.

Note: "Fetch" can be taken to apply to move a qty of lumber to the R/A saw from scrap bin, component cutter, or yard.

HOOVER UNIVERSAL - BUILDING PRODUCTS DIVISION

MADISON PLANT

ATTACHMENT 6

RECOMMENDED - TRIAL 1

LABOR PERFORMANCE FACTORS - MAN MINUTES

A Fetch Lumber to Comp. Saw	B Set up Component Saw	C Cut 1-pc. on Comp. saw	D Position Jigging	E Get Materials	F Handling & Banding	
7.5	4.2	0.3	32.0	19.9	28.8	Common trusses
						Specials
						System 42

A Fetch Lumber to R/A saw	B Set up R/A Saw	C Cut 1-pc. on R/A saw	
3.7	3.1	0.8	Common trusses
			Specials
			System 42

ASSEMBLY TIME PER PC. (MAN-MIN) WEIGHT FACTORS

A For 1 to 3 Trusses	B For 4 to 15 Trusses	C For 16 to 99 Trusses	D Over 99 Trusses	E for 50% More Gross Weight	F for 20% More Wt. per Pc.	
1.4	1.1	0.8	0.8	20 (%)	60 (%)	Common trusses
						Specials
						System 42

MISCELLANEOUS FACTORS

A % Extra Cutting Effort for 18' & 20" lumber	B Plate cost per 100 sq. in.	C Flat Truss Splices 1 = Off panel 2 = Panel pt.	D Maximum Lumber Length
30 (%)			

HOOVER UNIVERSAL - BUILDING PRODUCTS DIVISION

RECOMMENDED LABOR FACTORS - TRIAL 1

	Code	Total mm	mm/Truss	mm/pc
A Fetch Lumber to Component Saw	(8)	8.4		
	(14)	10.8		
	(20)	3.2		
Average (3 fetches)		7.5		

Note 1: "Fetch" operation assumes a crew of (2) since a second man is idled during the operation.

Note 2: Large variation was noted. Recommend use average of (3) fetch operations observed.

B Set Up Component Saw	(15)	5.4		
	(22)	3.0		
Average (2 setups)		4.2		

Note 1: "Setup" requires a crew of (2) since handler is idled while sawyer makes setup.

Note 2: Variation was noted, so recommend use average of (2) setup observations.

C Cut 1-Pc. on Component Saw	(17)			0.3

Note 1: Crew = 2

Note 2: Time includes auxiliary elements required to saw complete job (pick up scrap, saw and check samples, etc. - see separate sheet)

D Position Jigging	(4)	32.0		

Note 1: Recommend observation (4) only be used to establish this element due to experienced setup man, etc. Observations (13), (19) were accomplished by inexperienced operator. Also, no time pressure existed during observation (19).

RECOMMENDED LABOR FACTORS - TRIAL 1

	Code	Total mm	mm/Truss	mm/pc
-E Get Materials	(5)	19.9		
Note 1: This is only realistic "Get Materials" observation obtained.				
-F Handling and Banding				
Note 1: This input represents (1) unit load, taken = 28 trusses				
Note 2: Computations				
(a) Handling	(3)	0.8 mm/Truss		
(Racking)	(25)	0.6		
Avg.		0.7		
0.7 mm/Truss x 28 Trusses =		196.6 mm		
(b) Banding (only) Avg.	(7) (26)	6.1 mm, 7.2 mm, 6.7	=	6.7 mm
(c) Move banded unit to yard storage	(27)		=	2.5
				28.8 mm
-A Fetch Lumber to R/A Saw	(28)	3.7		
Note 1: 3.7 mm is based on fetching a bunk of lumber from yard to R/A saw with fork lift. Lumber cut on R/A saw is frequently recieved from component saw or scrap pile. The fetch figure should be reduced in both latter cases.				
B Set Up R/A Saw	(9)	3.1		
C Cut 1-Pc. on R/A Saw	(10)			1.2
Note 1: (See (z) separate sheets) Cut time includes necessary auxiliary elements.	(11)			0.4
	Avg.			0.8

	Code	Total mm	mm / Truss	mm / pc
C Assembly				
31' Howe	(1)			0.7
31' Howe	(2)			0.8
34' Double pitch	(23)			0.8
Small double pitch	(24)			0.8
Avg.				0.8

HOOVER UNIVERSAL - BUILDING PRODUCTS DIVISION

MADISON PLANT

ATTACHMENT 8

RECOMMENDED - TRIALS 2 & SUBS.

LABOR PERFORMANCE FACTORS - MAN MINUTES

A Fetch Lumber to Comp. Saw	B Set up Component Saw	C Cut 1-pc. on Comp. saw	D Position Jigging	E Get Materials	F Handling & Banding	
16.4	9.2	0.7	70.1	43.6	63.1	Common trusses
						Specials
						System 42

A Fetch Lumber to R/A saw	B Set up R/A Saw	C Cut 1-pc. on R/A saw	
8.1	6.8	1.8	Common trusses
			Specials
			System 42

ASSEMBLY TIME PER PC. (MAN-MIN) WEIGHT FACTORS

A or to 3 russes	B For 4 to 15 Trusses	C For 16 to 99 Trusses	D Over 99 Trusses	E for 50% More Gross Weight	F for 20% More Wt. per Pc.	
3.1	2.5	1.8	1.8	20%	60%	Common trusses
						Specials
						System 42

MISCELLANEOUS FACTORS

A Extra utting Effort or 18' & 20" lumber	B Plate cost per 100 sq. in.	C Flat Truss Splices 1 = Off panel 2 = Panel pt.	D Maximum Lumber Length
30%			

ADDENDUM TO HOOVER UNIVERSAL -

BUILDING PRODUCTS DIVISION

FINAL REPORT

ASSEMBLY TIME FOR "SPECIAL" TRUSS JOBS

SPECIALS

On Friday, June 15, 1979, I made an abbreviated study of the assembly time required for two sets of (10) "special" trusses being run at the Madison plant. The trusses observed were dual-pitched trusses of a common design, but were comprised of fire-treated (heavier) lumber, 44 feet long (overlength), with both ends cantilevered and with "2 x 6" top and bottom chords.

The results of these two studies are presented on the attached sheet. Note that the average man-minutes per piece for these special trusses was determined to be 1.4 mm/pc, compared to an average 0.8 mm/pc calculated for common trusses (see Attachment 7, page 3). Therefore, the assembly time per piece (for 16 to 99 trusses) should be input as 1.4 x 2.19 = 3.1 mm/pc when using the program for pricing "specials." The corresponding input figures for smaller job quantities should then be factored upward using the same ratios as for common trusses.

ADDENDUM TO HOOVER UNIVERSAL FINAL REPORT

OBSERVATIONS OF "SPECIAL" TRUSSES

Code	Date	No. Obs	Operation	Description	Elapsed Min.	Crew Size	Man-Min (mm)	Trusses	mm/Truss	No. Pcs.	mm/pc.
(29)	6/15/79	10	Assembly	44' Special Truss-fire-treated lumber	42.7	6	256.2	10	25.6	17	1.5
(30)	6/15/79		Assembly	44' Special Truss-fire-treated lumber	36.7	6	220.2	10	22.0	17	1.3

Avg. - (20) observations 1.4 mm/